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PENSOFT

First confirmed records of Godman's Long-tailed Bat, *Choeroniscus godmani* (Thomas, 1903) (Chiroptera, Phyllostomidae), from Brazil and Panama

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Abstract

We report on the occurrence of *Choeroniscus godmani* (Thomas, 1903) in Brazil and Panama. The Panama record fills a distribution gap for the species in Central America. The three records from Brazil are from the Amazonia in the state of Pará, and from the Cerrado and an Amazonia/Cerrado ecotone in the state of Mato Grosso. At two localities in Brazil, *C. minor*, a larger species of *Choeroniscus*, was also recorded. These new records extend the distribution of *C. godmani* by 2,065 km south to central South America. One of the Brazilian specimens represents the first record of supernumerary incisors in *C. godmani*.

Keywords

Amazonia, Central America, Cerrado, Glossophaginae, polyodontia

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Introduction

The long-tailed bat genus *Choeroniscus* Thomas, 1928 (Chiroptera, Phyllostomidae) include three species: *C. minor* (Peters, 1868), *C. periosus* Handley, 1966, and *C. godmani* (Thomas, 1903) (Griffiths and Gardner 2008; Solari et al. 2019). The genus can be diagnosed by its small to medium-sized body (forearm 31–42 mm), bicolored dorsal fur, with pale base and dark brown tips; the presence of a moderately developed tail that reaches the proximal third of the uropatagium and perforates it dorsally, and paired inflated pterygoid hamulae which may be in contact with the auditory bullae (Griffiths and Gardner 2008). The much-reduced teeth crowns and the dental formula of I 2/0, C 1/1, P 2/3, M 3/3 × 2 = 30 also characterize the three species of the genus.

The smallest species of the genus, *C. godmani* has a wide distribution, with confirmed records in Mexico,

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Guatemala, El Salvador, Nicaragua, Honduras, Costa Rica, Colombia, Venezuela, Guyana, French Guiana, and Suriname (Solari et al. 2019). However, the records are sparse and there are some distribution gaps, such as the absence of confirmed records from Panama and Brazil (Tavares and Molinari 2015; Díaz et al 2021). Presley et al. (2008) reported a specimen of *C. godmani* from Tapajós National Forest and Tavares et al. (2012) listed "*Choeroniscus* aff. *godmani*" from the vicinities of Floresta Nacional de Carajás, both from eastern Amazonia, in the Brazilian state of Pará, but no vouchers were mentioned. For this reason, the occurrence of this species in Brazil was considered likely but unconfirmed in subsequent checklists (Nogueira et al. 2014; Garbino et al. 2020). Likewise, specimens of *C. godmani* from Panama are listed in the Global Biodiversity Information Facility (GBIF, https://www.gbif.org/) and the Smithsonian Tropical Research Institute (STRI, https://panamabiota.org/stri/) databases, but the identification of the vouchers has not been verified.

The ecology and distribution of *C. godmani* is relatively well studied in the central and northern part of its range (Arends et al. 1995; Valiente-Banuet et al. 1997, 2004; Castaño et al. 2004; Magaña-González et al. 2008). The available data on the biology of this species, as well as relatively high capture rates in some regions, has resulted in the IUCN Red List category classification of Least Concern (Tavares and Molinari 2015). On the other hand, there is virtually no ecological data available for the southern part of the geographic range of *C. godmani*.

Here we report the first documented records of *C. godmani* from Brazil and Panama, with two records of sympatry with *C. minor* in Brazil. Our records extend the distribution of the species to central Brazil and fill a distribution gap in Central America. We also report on the second known case of anomalous dental formula for *C. godmani*.

Methods

Data collection. We studied specimens in the Universidade Federal de Minas Gerais (UFMG), Belo Horizonte; Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo; National Museum of Natural History, Smithsonian Institution (USNM), Washington, DC; Museu de Zoologia da Universidade Estadual de Campinas (ZUEC), Campinas. We also examined the holotype of *C. godmani* in the Natural History Museum (BMNH), London. We took a total of six measurements of the skull with digital calipers (to the nearest 0.01 mm) (Woodman and Timm 2006): greatest length of skull, breadth of post-orbital constriction, braincase breadth, length of maxillary toothrow, breadth across canines, and length of mandible. We also measured the forearm length of specimens. External measurements of head and body, and tail lengths, and weight were retrieved from specimen tags.

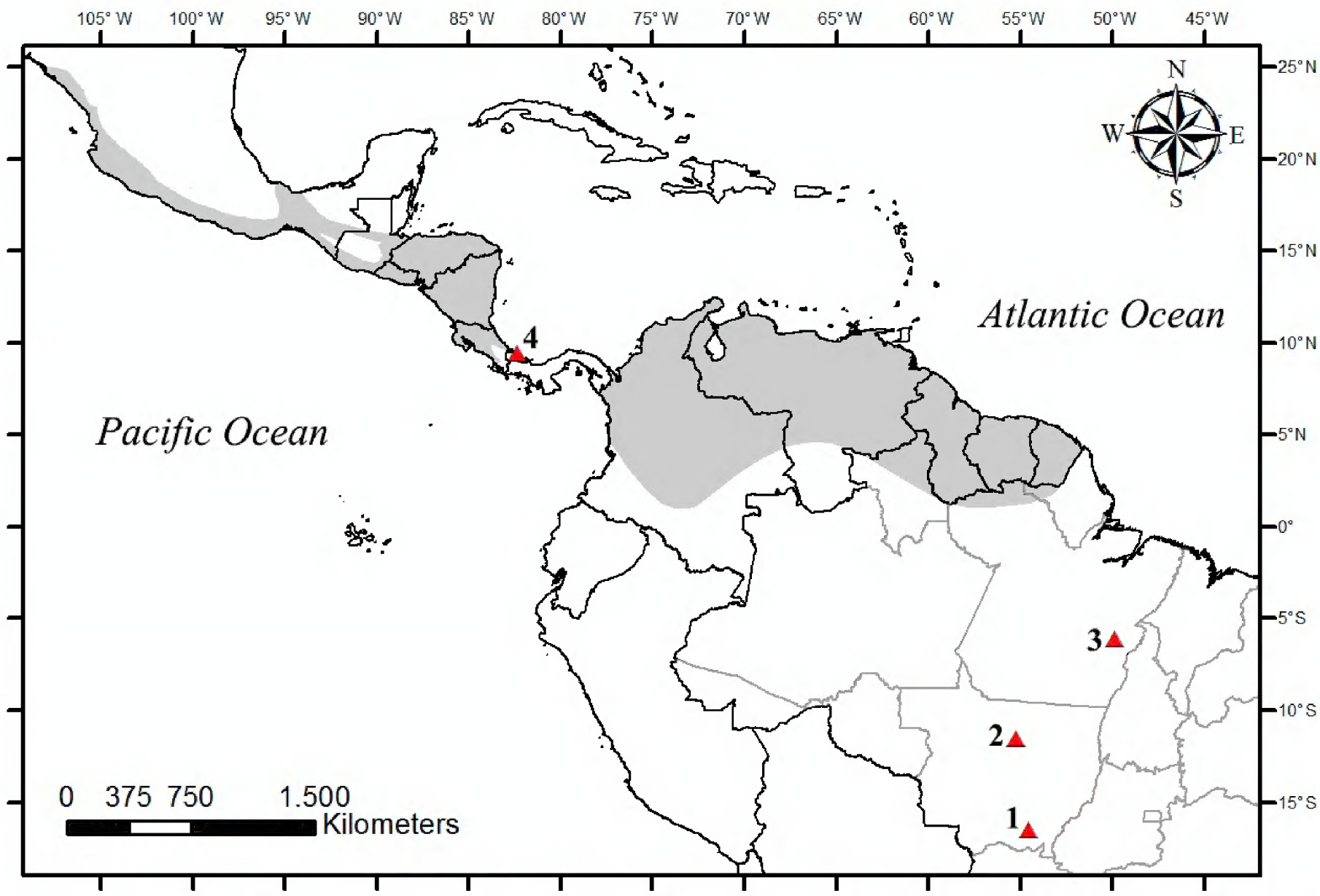

Figure 1. Geographic distribution of *Choeroniscus godmani* in Central and South America (shaded gray) as per Tavares and Molinari (2015). New records: BRAZIL: Mato Grosso state, Rondonópolis, Posto Indígena Tadarimana (1) and Cláudia (2); Pará state, Parauapebas (3); PANAMA: Ngäbe-Buglé comarca indígena, Peninsula Valiente, Quebrada Hido (4).

Results

Choeroniscus godmani (Thomas, 1903)

New records. PANAMA – **Ngäbe-Buglé** • Kusapín, Península Valiente, Quebrada Hido; 09°10′N, 081°53′W (locality 4, Fig. 1); alt. ca. 0 m a.s.l.; 25.IV.1990; C.O. Handley Jr. leg; 1 adult ♂, taxidermied skin with separated skull and partial skeleton, COH-JR 16913; USNM 578191.

BRAZIL – **Pará** • Parauapebas, Fazenda do Mauro; 05°58′49″S, 049°54′47″W (locality 3, Fig. 1); alt. ca. 296 m a.s.l.; 06.V.2007; V.C. Tavares and T. Dornas leg.; 1 subadult ♂, specimen in fluid with separated skull, VCT 1100; UFMG 7772 • Parauapebas, Fazenda do Mauro; 05°58′49″S, 049°54′47″W (locality 3, Fig. 1); alt. ca. 296 m a.s.l.; 06.V.2007; V.C. Tavares and R.F. Silva leg.; 1 adult ♀ (pregnant with a single fetus), specimen in fluid with separated skull, VCT 1076; UFMG 7773 – **Mato Grosso** • Cláudia; 11°33′S, 055°11′W (locality 2, Fig. 1); alt. ca. 370 m a.s.l.; 06.VI.1997; M. Kerr leg.; 1 adult ♀, taxidermied skin with separated skull, PEV734-735; MZUSP 36021 • Rondonópolis, Posto Indígena Tadarimana; 16°31′S, 054°30′W (locality 1, Fig. 1); alt. ca. 250 m a.s.l.; 08.VII.1977; V.S. Dias leg.; 1 unknown sex, skull only, ZUEC-MAM 1576.

Choeroniscus minor (Peters, 1868)

New records. BRAZIL – **Mato Grosso** • Cláudia; 11° 33′S, 055°11′W; alt. ca. 370 m a.s.l.; 08.VI.1997; M. Kerr leg.; 1 adult ♀, pregnant with a single fetus, taxidermied skin with separated skull, PEV777-778, MZUSP 35006.

Remarks. All specimens were captured with mist nets placed on ground level. One of the two specimens of *C. godmani* from Mato Grosso state (MZUSP 36021) has an extra pair of upper incisors on both sides of the premaxilla, instead of the regular number of two upper incisors (Fig. 4). The four specimens from Brazil show no significant differences among each other, other than the extra pair of incisors in one specimen. We compared these specimens to the holotype of *C. godmani* (BMNH 79.12.24.1) and the only difference between it and the Brazilian samples was the absence of a palatine cleft in our samples. One of the specimens from Pará (UFMG 7773) was a pregnant female with a single fetus. At two of the localities, in Cláudia (Locality 2, Fig. 1) and in Parauapebas (Locality 3, Fig. 1), both *C. godmani* and *C. minor* were collected together. The specimen of *C. minor* from Cláudia was pregnant, carrying a single fetus, and it was captured in a mist net placed near a bridge of a stream. Tavares et al. (2012) reported *C. minor* from Parauapebas.

Identification. Specimens were identified as *Choeroniscus* based on the inflated hamular process of the pterygoid, incomplete zygomatic arches, absence of lower incisors, bicolored dorsal fur, and tail reaching proximal third of uropatagium (Figs. 2, 3). *Choeroniscus godmani* is distinguished from *C. minor* by the relatively smaller cranial dimensions, as both species have similar forearm length (Table 1). In *C. godmani* there is a conspicuous notch in the lateral posterior border of the palatine,

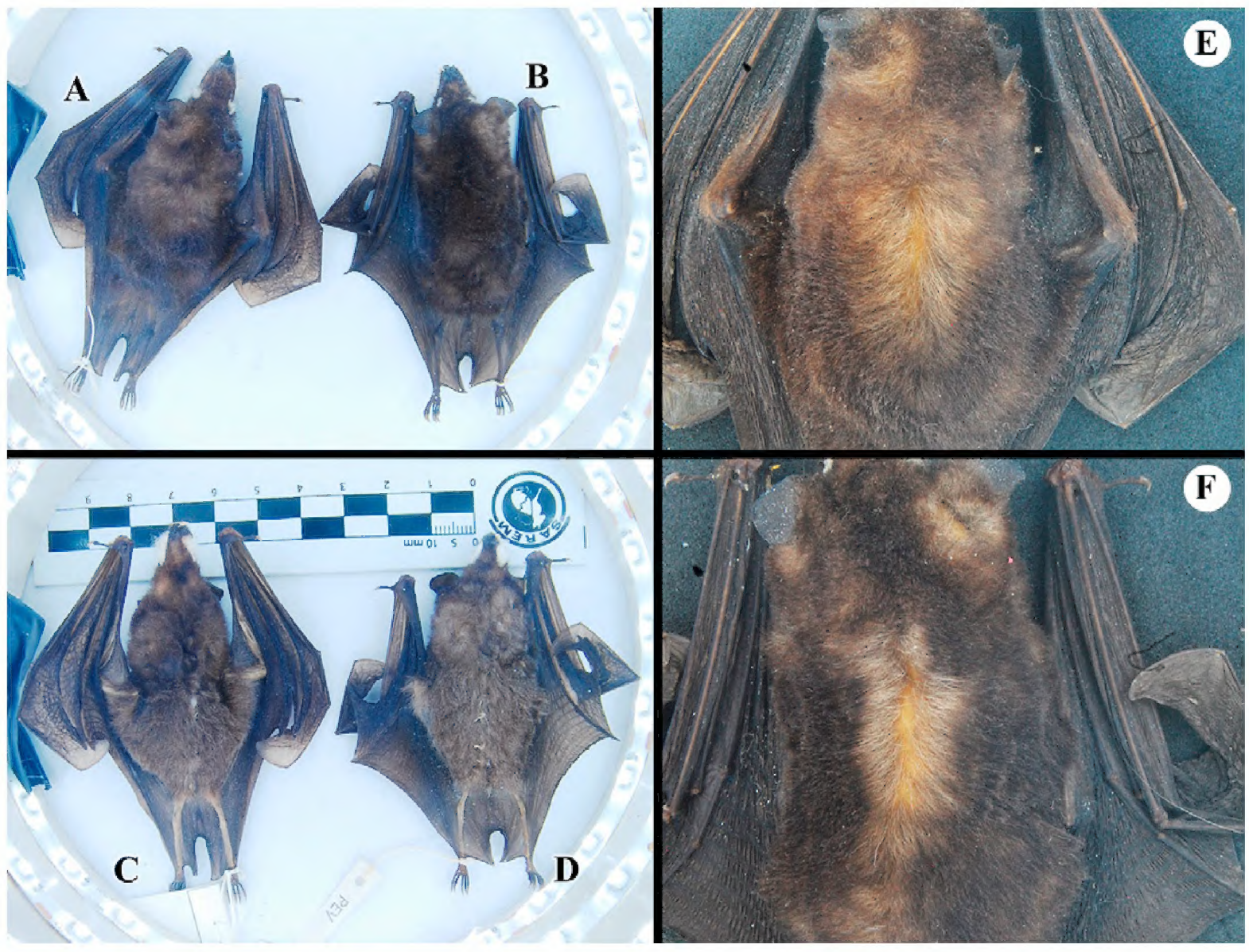

Figure 2. *Choeroniscus minor* MZUSP 35006 (**A**, **C, E**) and *Choeroniscus godmani* MZUSP 36021 (**B**, **D**, **F**), both from Cláudia, Mato Grosso, Brazil. **A.** Skin, dorsal view. **B.** Skin, dorsal view. **C.** Skin, ventral view. **D.** Skin, ventral view. **E.** Detail of pelage bands, dorsal view. **F.** Detail of pelage bands, dorsal view. Note the contrast between basal and terminal bands in the dorsal pelage of *C. minor* (**C**) and *C. godmani* (**F**).

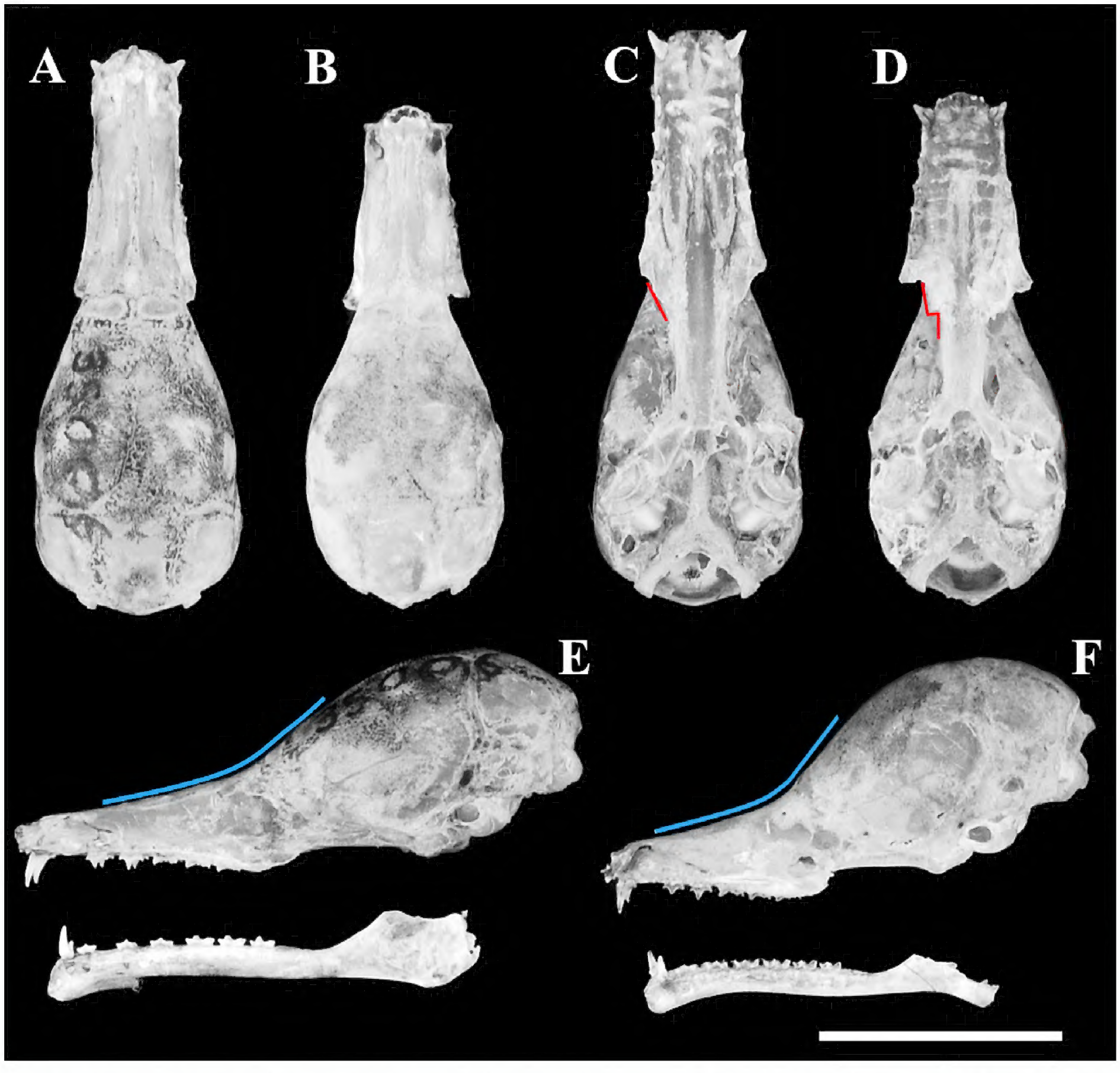

Figure 3. *Choeroniscus minor* MZUSP 35006 (**A**, **C, E**) and *Choeroniscus godmani* MZUSP 36021 (**B**, **D**, **F**), both from Cláudia, Mato Grosso, Brazil. **A.** Skull, dorsal view. **B.** Skull, dorsal view. **C.** Skull, ventral view. **D.** Skull, ventral view. **E.** Skull, lateral view. **F.** Skull, lateral view. The red lines indicate the notched lateral posterior border of the palatine in *C. godmani*, versus a continuous border in *C. minor*, and the blue lines show the cranium markedly elevated in *C. godmani*, versus a much less marked elevation in *C. minor*. Scale bar: 10 mm.

whereas in *C. minor* this border is continuous. Also, the cranium of *C. godmani* is markedly elevated from the basicranial plane, whereas in *C. minor* the elevation of the cranium is much less marked (Diaz et al. 2016, 2021) (Fig. 3). Both *C. minor* and *C. godmani* are distinguished from *C. periosus* by their smaller size (forearm length <40 mm; Table 1) and shortened rostrum (rostral length shorter than braincase; Fig. 3). In contrast, *C. periosus* has a larger body size (forearm length >40 mm) and a longer rostrum, with a larger rostral length compared to the length of the braincase (Handley 1966).

Discussion

We confirm that *Choeroniscus godmani* occurs in Brazil, as suggested by previous studies (Presley et al. 2008; Tavares et al. 2012; Brandão et al. 2019). Our records also extend the range of *C. godmani* significantly to the south, by 2,065 km from its previous known locality, which is "Sipaliwini Airstrip", Suriname (Williams and Genoways 1980). With the record from Panama, we also fill part of a distribution gap for the species (Tavares and Molinari 2015; Solari et al. 2019). However, the record from Panama is near the border with Costa Rica and the species has not been recorded for a vast area in the country, where it is expected to occur.

Polyodontia has been commonly observed in *C. minor* (Husson 1962; Phillips 1971; Velazco et al. 2021), but only a single case was previously known for *C. godmani*. Phillips (1971) found an extra premolar in specimen AMNH 131765 from Costa Rica. Therefore, our record is the first report of supernumerary incisors for the species. The extra teeth are placed between the second upper incisors and the canines; they are peg-like and with a relatively

Table 1. External and cranial measurements and body mass of *Choeroniscus godmani* and *C. minor* reported here.

Measurements	***Choeroniscus godmani***					***Choeroniscus minor***
	USNM 578191	UFMG 7772	UFMG 7773	MZUSP 36021	ZUEC-MAM 1576	MZUSP 35006
Country	Panama, Peninsula Valiente	Brazil, Parauapebas	Brazil, Parauapebas	Brazil, Cláudia	Brazil, Rondonópolis, Posto Indígena Tadarimana	Brazil, Cláudia
Sex	Male	Male	Female	Female	Unknown	Female
Body mass (g)	6.5	8.0	8.0	8.3	—	7.8
Head and body length (mm)	50	—	—	48	—	49
Tail length (mm)	7.0	7.6	—	6.0	—	8.0
Forearm length (mm)	32.66	30.00	—	31.00	—	34.00
Greatest length of skull (mm)	19.06	20.63	21.19	20.65	20.17	23.09
Breadth of post-orbital constriction	—	3.72	3.79	3.25	3.80	3.80
Braincase breadth	8.03	8.02	8.06	7.79	8.22	8.05
Length of maxillary toothrow	6.80	7.27	7.15	7.18	7.07	8.48
Breadth across canines	3.34	3.32	3.79	2.96	3.13	3.41
Length of mandible	13.64	—	15.19	13.70	14.8	17.5

lower crown than usual for incisors (Fig. 4).

The records from eastern Amazonia, Pará state (locality 3, Fig. 1) are from an area adjacent to the Floresta Nacional de Carajás (FLONA Carajás), which is a protected area that also permits the sustainable use of resources. The Serra dos Carajás region harbors a mosaic of Amazonian rain forests and unique "canga" formations associated to the iron-rich substrate, containing rupicolous and aquatic vegetation. These formations harbor several endemic species and have thousands of iron caves forming cave networks and populated by unique invertebrate and bat communities (Tavares et al. 2012; Jaffé et al. 2016; Souza-Filho et al. 2019; Zappi et al. 2019). The FLONA Carajás is partially exploited for mining and is the site of the largest iron-ore mine in the world. Diverse assemblages of bats, totaling eight families, 46 genera, and 75 species, have been recorded from the FLONA (Tavares et al. 2012).

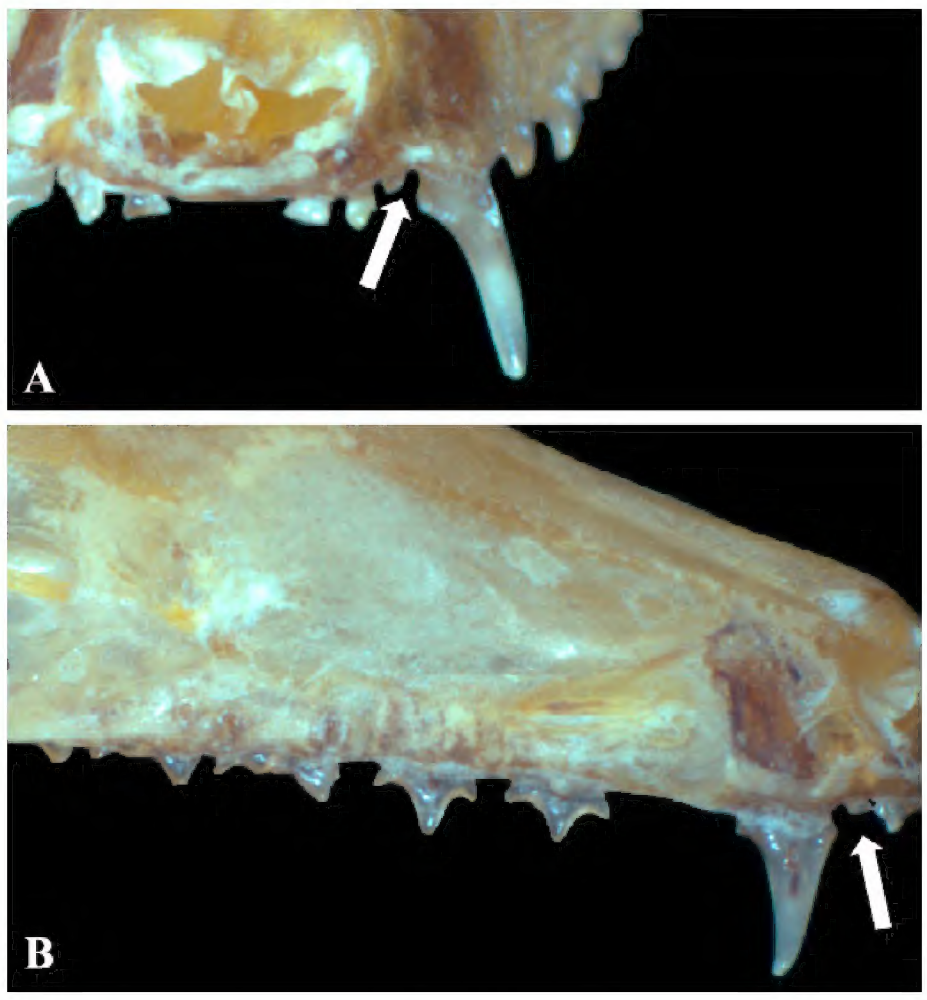

Figure 4. Rostrum of *Choeroniscus godmani* specimen (MZUSP 36021) with supernumerary upper incisors (arrows). **A.** Frontal view. **B.** Lateral view.

One of the records from Brazil (locality 2, Fig. 1) is inserted at the "Arc of Deforestation", an area at the southern and eastern borders of the Amazonia, and the other is located in the Cerrado domain (locality 1, Fig. 1). Both of these areas in Mato Grosso state are suffering intense deforestation and land conversion to soy plantations and cattle ranching (Yoshikawa and Sanga-Ngoie 2011; Marques et al. 2020). One of the localities (Posto Indígena Tadarimana, locality 1, Fig. 1) is inside indigenous land currently surrounded by plantations and pasture, and may function as a protected area for fauna as demonstrated elsewhere for other indigenous lands (Fernández-Llamazares et al. 2021).

Notably, the record from Panama is inside the Ngäbe-Buglé "comarca indigena", a special administrative area where indigenous groups have exclusive land rights and some political autonomy. The vegetation in Panama where the new record was made consists of humid forests of the Caribbean coast; this region is considered well preserved and important for biodiversity conservation in the country (ANAM 2010).

Our new records are based on museum vouchers, one of them collected 45 years ago (ZUEC-MAM 1576), reinforcing the importance of scientific collections and the need to continuously revise specimens (Moratelli 2014). Both specimens from Mato Grosso reported here, for example, were previously identified as *Glossophaga* sp. on their respective field labels.

With the new records, Brazil has now 182 bat species confirmed in its territory (Garbino et al. 2020). Considering the latest accounts and records, and including the recently described *Vampyressa elisabethae* Tavares et al., 2014 and our new record of *C. godmani*, there are now 113 species of bats recorded in Panama (Samudio and Pino 2014; Tavares et al. 2014; Díaz et al. 2021).

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Authors' Contributions

Conceptualization: MVB, VDCT, GG. Data curation: VDCT, GG, MVB. Formal analysis: MVB, GG, VDCT. Investigation: VDCT, GG, MVB. Methodology: VDCT, GG, MVB. Visualization: GSTG, MVB. Writing – original draft: GG, MVB, VDCT. Writing – review and editing: MVB, VDCT, GG.

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